

OMNO2 Release Notes

These Release Notes describe changes that have been made to the OMI NO₂ data set, OMNO2. Only changes made since the provisional release (2005-11-21) are listed.

Version 1.0.0, Released 2006.09.08

Public Release

- (1) Level-2 files now contain three main types of vertical column NO₂ and estimates of their uncertainties. These are the observed total column (*ColumnAmountNO2*), the observed tropospheric (*ColumnAmountNO2Trop*) column, and observed polluted column (*ColumnAmountNO2Polluted*). The fields for the unpolluted column (*ColumnAmountNO2Unpolluted*) and its uncertainty (*ColumnAmountNO2UnpollutedStd*) now contain only fill values. As before, the smooth field is defined by the Fourier coefficients, which are included in the file.
- (2) The files also contain an estimate of the column amount hidden any clouds in the field of view (*ColumnAmountNO2BelowCloud*). This quantity – also called the “ghost column” - and its uncertainty are given for each OMI pixel with measurable pollution and a defined cloud fraction greater than zero. It is not a fixed quantity from a look-up table, but is computed from on the measured column amount and the *a priori* tropospheric profile shape. *ColumnAmountNO2BelowCloud* can be added to the total, tropospheric or polluted columns to obtain the respective complete columns, which are independent of cloud amount. However, the ghost column amount becomes less certain as the cloud fraction increases, particularly for cloud fractions > ~40%. Therefore, the user should carefully consider cloud information when selecting data for use in validation studies or other investigations.
- (3) A summary flag is now included with each observation to alert the user to the presence of one or more significant data quality issues.
- (4) Cloudy and clear components of the AMFs (both polluted and unpolluted) are now defined relative to the above-ground vertical column (previously they were relative to the visible column and thus contained cloud fraction information). The values of the radiance-weighted sums of the clear and cloudy AMF components are unaffected by this change.
- (5) Uncertainty calculations for all quantities have been improved since the provisional release. Air-mass factor uncertainties are now dependent on cloud parameters, terrain reflectivity and estimated *a priori* profile variability. In all calculations, cloud-fraction uncertainty is fixed at ± 0.05 .

(6) The relationships among the column amounts and air mass factors in the current OMI algorithm are as follows:

$$A_u = w \cdot A_u^{cloudy} + (1-w) \cdot A_u^{clear}$$

$$A_p = w \cdot A_p^{cloudy} + (1-w) \cdot A_p^{clear}$$

$$A_p^{obs} = A_p \cdot (V_p / V_p^{obs}) \big|_{a\ priori}$$

$$V_p^{obs} \big|_{a\ priori} = f \cdot V_p^{above\ cloud} \big|_{a\ priori} + (1-f) \cdot V_p \big|_{a\ priori}$$

$$V_{init} = S / A_u$$

Unpolluted Case:

$$V = V_{init}$$

$$V_{trop} = V_{init} \cdot t$$

Polluted Case:

$$V_p^{obs} = (V_{init} - V_u) \cdot (A_u / A_p^{obs})$$

$$V_{trop}^{obs} = V_p^{obs} + V_u \cdot t$$

$$V^{obs} = V_p^{obs} + V_u$$

$$V_{strat} = V^{obs} - V_{trop}^{obs}$$

$$V_{ghost} = (V_{init} - V_u) \cdot (A_u) \cdot (1/A_p - 1/A_p^{obs})$$

$$V_p = V_p^{obs} + V_{ghost}$$

$$V_{trop} = V_{trop}^{obs} + V_{ghost}$$

$$V = V^{obs} + V_{ghost}$$

In the above expressions, A is an air mass factor, V is a vertical column amount, S is a slant column amount, f is the effective cloud fraction, w is the cloud radiance fraction and t is the tropospheric fraction of the unpolluted column (about 0.05). The subscripts are p for polluted, u for unpolluted and $init$ for initial. The air mass factor superscripts are *clear* for clear-sky, and *cloudy* for overcast sky. The column superscripts are *above-cloud* (indicating integration from cloud top to infinity), and *obs* for the observed column (the column above cloud or ground that is visible to the satellite). Column amounts labeled *a priori*, were

calculated by integrating an a priori NO₂ profile. V^{obs} , V_p^{obs} and V_{trop}^{obs} are retrieved observed column amounts, and V , V_p , V_{trop} are the corresponding amounts above ground, computed by adding estimates of the below-cloud column to the visible column. V_u is the smooth unpolluted field from the planetary-wave analysis.

Version 0.9.1, Released 2006.05.15

- (1) A bug was identified and fixed. The cloud reflectivity assumed when reading and interpolating the dAMF file was not consistent with the cloud reflectivity assumed in the Level-2A cloud parameters from the O₂-O₂ cloud algorithm.

Prior to this version, a cloud reflectivity of 85% had been used in the OMNO2B algorithm, rather than the value of 80% assumed in the O₂-O₂ cloud algorithm. A value of 80% is now assumed throughout the calculation. The effect of this change has not been quantified, but is expected to be minor.